The Terrapin™ Logo Language for the Apple® II, II+, IIe and IIc.

64K and 128K Versions

The Terrapin™ Logo Language

The Terrapin Logo Language for the Apple® II, II+, IIe and IIc.

64K and 128K Versions

Terrapin Logo is . . .

- The Logo of choice for the educational environment—currently in use in over 10,000 schools world-wide.
- The ideal Logo for beginners—with award-winning documentation written in a clear, fun to read style.
- A powerful Logo for experienced programmers —with a complete technical manual.
- Supported by unmatched technical support— with complete and prompt assistance.

Terrapin, Inc.
Terrapin, Inc., 222 Third Street,
Cambridge, MA 02142 (617) 492-8816

ISBN 0-927510-00-6

Terrapin Logo Quick Reference Card
GRAPHICS COMMANDS
BACK (1) BK
BACKGROUND (1) BG
CLEARSCREEN CS
DRAW
Moves turtle backward.
Background color.
The Terrapin™ Logo Language for the Apple® II
Utilities Disk
64K and 128K Versions
© Terrapin, Inc., 1982, 1983, 1984; © M.I.T., 1980, 1981
WARRA
This warra
proper wa
Product De
Purchased
Store's Add
SCH
Your Name
School
Address
City
Zip
Grade Leve

PENCOLOR (1) PD

PENDOWN PU

PENUP RT

RIGHT (1) SETH

SETHEADING (1)

SETX (1)

Causes no trail (line) when turtle moves.

Rotates the turtle to the right.

Rotates the turtle to specified heading straight up.

Moves the turtle horizontally to specified

WARRANTY REGISTRATION

This warranty card must be fully completed and returned for proper warranty coverage.

Product Description

Purchased From

Store's Address

☐ SCHOOL

Your Name

School

Address

City State

Zip Tel#

Grade Level Taught

The Terrapin™ Logo Language for the Apple® II
Language Disk

64K and 128K Versions

№ 69251

©Terrapin, Inc., 1982, 1983, 1984, 1985.
©M.I.T., 1980, 1981

The Terrapin™ Logo Language for the Apple® II
Utilities Disk

64K and 128K Versions

© Terrapin, Inc., 1982, 1983, 1984; © M.I.T., 1980, 1981

The Terrapin™ Logo Language
for the Apple® II
Language Disk

©Terrapin, Inc., 1982, 1983, 1984, 1985,
©M.I.T., 1980, 1981

64K and 128K
Versions

№ 69251

The Terrapin™ Logo Language
for the Apple® II
Utilities Disk

© Terrapin, Inc., 1982, 1983, 1984; © M.I.T., 1980, 1981

4K and 128K
Versions

69251

The Terrapin™ Logo Language
for the Apple® II
Utilities Disk

64K and 128K
Versions

© Terrapin, Inc., 1982, 1983, 1984; © M.I.T., 1980, 1981

SETHE

SETX (1)

WARRA

This warrant
proper warra

Product Desc
Purchased F
Store's Addre

☐ SCHO

Your Name
School
Address
City
Zip
Grade Level T

The Terrapin™ Logo Language
for the Apple® II
Language Disk

64K and 128K
Versions

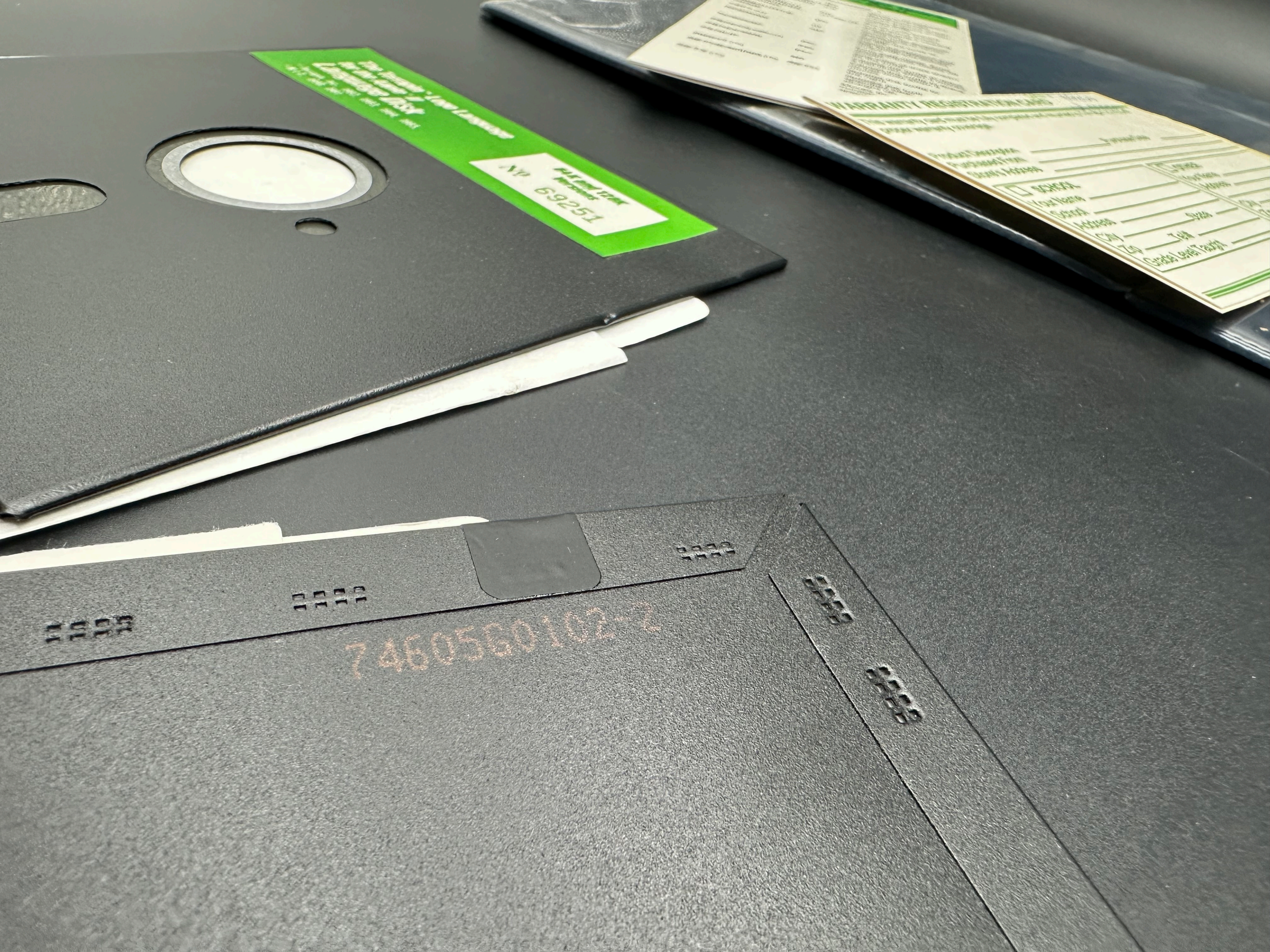
№ 69251

©Terrapin, Inc., 1982, 1983, 1984, 1985.
©M.I.T., 1980, 1981

The Terrapin™ Logo Language
for the Apple® II
Utilities Disk

64K and 128K
Versions

© Terrapin, Inc., 1982, 1983, 1984; © M.I.T., 1980, 1981


NP 69251
WARRANTY REGISTRATION
7460560102-2

Utilities Disk

© Terrapin, Inc., 1982, 1983, 1984, © M.I.T., 1980, 1981

NINETY - DAY WARRANTY

Terrapin, Inc. (hereinafter referred to as "Terrapin") warrants the products it manufactures against defects in material and workmanship for a period of ninety days from the date of purchase. Products manufactured by Terrapin can be identified by the "Terrapin" trademarks, trade name, or logo affixed to them.

During the warranty period, Terrapin will replace at no charge components that prove to be defective, provided the Terrapin product is returned, shipping prepaid to Terrapin or an authorized Terrapin distributor.

You may request information on how to exchange the goods by contacting Terrapin directly at the address above. Your sales receipt is your warranty validation. Dated proof of purchase (such as bill of sale or cancelled check) must be provided when requesting warranty replacement.

This warranty does not apply if, in the opinion of Terrapin, the product has been damaged by accident, misuse, missapplication, or as the result of a modification by other than Terrapin or an authorized Terrapin distributor.

WARRANTY REGISTRATION CARD

Serial # 69250

W 69251

This warranty card must be fully completed and returned to Terrapin to insure proper warranty coverage.

Purchase Date

Product Description

Purchased From

Store's Address

☐ SCHOOL

Your Name

School

Address

City State

Zip Tel#

Grade Level Taught

☐ OTHER

Your Name

Address

City State

Zip Tel#

Occupation

Terrapin

"NO OTHER WARRANTIES ARE EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF , MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. TERRAPIN IS NOT RESPONSIBLE FOR CONSEQUENTIAL DAMAGES." Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific legal rights and you may also have other rights which vary from state to state.

From _____

_____

_____

Place
Stamp
Here

Terrapin, Inc.
222 Third Street
Cambridge, Massachusetts 02142

Terrapin Logo Quick Reference Card

GRAPHICS COMMANDS

BACK (1)	BK	Moves turtle backward.
BACKGROUND (1)	BG	Background color.
CLEARSCREEN	CS	Clears graphics screen.
DRAW		Clears graphics screen—homes turtle.
FORWARD (1)	FD	Moves turtle forward.
FULLSCREEN	⟨CTRL⟩F	Full graphics screen.
HEADING		Returns turtle's heading in degrees.
HIDETURTLE	HT	Makes turtle disappear.
HOME		Moves turtle to center of screen.
LEFT (1)	LT	Rotates the turtle to the left.
NODRAW	ND	Clears the graphics and text screen. Enters text only mode and homes cursor.
NOWRAP		Exits wrap mode. Error occurs if turtle moves off screen.
PENCOLOR (1)	PC	Sets color of lines drawn by the turtle.
PENDOWN	PD	Causes the turtle to leave a trail (line) when it moves.
PENUP	PU	Causes the turtle to leave no trail (line) when it moves.
RIGHT (1)	RT	Rotates the turtle to the right.
SETHEADING (1)	SETH	Rotates the turtle to the specified heading. Zero is straight up.
SETX (1)		Moves the turtle horizontally to the specified position.
SETXY (2)		Moves the turtle to the specified X,Y coordinate. The center of the screen is 0,0.
SETY (1)		Moves the turtle vertically to the specified position.
SHOWTURTLE	ST	Causes the turtle to appear.
SPLITSCREEN	⟨CTRL⟩S	Mixed graphics and text on screen.
TEXTSCREEN	⟨CTRL⟩T	Text only on screen.
TOWARDS (2)		Rotates the turtle to point toward the X,Y coordinates.
TURTLESTATE	TS	Returns status of the turtle.
WRAP		Allows the turtle to move off the screen and reappear at the opposite edge.
XCOR		Returns the turtle's X-coordinate.
YCOR		Returns the turtle's Y-coordinate.

COLORS:

NUMBER	COLOR
0	Black
1	White
2	Green
3	Violet
4	Orange
5	Blue
6	Reverse

NON-EDITING CONTROL CHARACTERS

⟨CTRL⟩ F	Full graphics screen.
⟨CTRL⟩ G	Stops program execution.
⟨CTRL⟩ S	Split screen.
⟨CTRL⟩ T	Full text screen.
⟨CTRL⟩ W	Pause during listing.
⟨CTRL⟩ Z	Pause.

KEYBOARD EDITING COMMANDS

⟨DELETE⟩	Erases character to left of cursor.
⟨ESC⟩	Erases character to left of cursor.
⟨ARROW KEYS⟩	Moves cursor.
⟨CTRL⟩ A	Moves cursor to the beginning of the current line.
⟨CTRL⟩ B	Displays previous screen of text.
⟨CTRL⟩ C	Exits editor—makes changes.
⟨CTRL⟩ D	Erases character at cursor.
⟨CTRL⟩ E	Moves cursor to end of current line.
⟨CTRL⟩ F	Displays next screen of text.
⟨CTRL⟩ G	Exits editor—no changes.
⟨CTRL⟩ X	Deletes to end of line.
⟨CTRL⟩ L	Scrolls line with cursor to center of screen.
⟨CTRL⟩ N	Moves cursor to the next line.
⟨CTRL⟩ O	Open a new line.
⟨CTRL⟩ P	Moves cursor to the previous line.
⟨CTRL⟩ Y	Restores most recently deleted line(s).

Terrapin™
The Original Logo People

Terrapin Inc., 222 Third Street
Cambridge, MA 02142, (617) 492-8816

Terrapin, Inc. (hereinafter re
against defects in material a
purchase. Products manuf
trademarks, trade name, or

During the warranty period,
defective, provided the Ter
authorized Terrapin distrib

You may request informati
at the address above. You
purchase (such as bill of sa
warranty replacement.

This warranty does not ap
accident, misuse, missapp
an authorized Terrapin dis

Other Terrapin Logo Commands

NUMERIC OPERATIONS

+	Addition.
-	Subtraction.
*	Multiplication.
/	Division.
>	Greater than.
<	Less than.
ATAN (2)	Returns the arctangent of the quotient of two inputs.
COS (1)	Returns cosine.
INTEGER (1)	Truncates the fractional part of a number.
NUMBER? (1)	Returns TRUE if input is a number.
QUOTIENT (2)	Returns the integer quotient of two inputs.
RANDOM (1)	Returns a repeatable sequence of random numbers.
RANDOMIZE (0)***	Varies the input seed for random.
REMAINDER (2)	Returns the integer remainder.
ROUND (1)	Returns the nearest integer.
SIN (1)	Returns the sine.
SQRT (1)	Returns the square root.

WORDS AND LISTS OPERATIONS

=		Compares inputs and returns TRUE or FALSE.
BUTFIRST (1)	BF	Returns all but the first element (character) of a list (word).
BUTLAST (1)	BL	Returns all but the last element (character) of a list (word).
COUNT (1)		Returns the number of elements in its input.
FIRST (1)		Returns the first element (character) of a list (word).
FPUT (2)		Returns a list of the first input then the elements of the second input.
ITEM (2)		Returns the specified (by first input) element of the second input.
LAST (1)		Returns the last element (character) of a list (word).
LIST (2)*		Returns a list of its inputs.
LIST? (1)		Returns TRUE if input is a list.
LPUT (2)		Returns a list of second input then the first input.
SENTENCE (2)*	SE	Returns a one-level list from inputs.
WORD (2)*		Concatenates the characters of the input words.
WORD? (1)		Returns TRUE if the input is a word (or number).

DEFINING AND EDITING PROCEDURES

DEFINE (2)		Used by procedures to define other procedures.
EDIT **	ED	Enters edit mode.
END		Terminates a procedure definition.
ERASE **	ER	Erases designated procedures from the workspace.
ERNAME (1)		Removes the global variable from the workspace.
TEXT (1)		Accepts a procedure name and returns procedure text as a list.
TO **		Begins procedure definition. Enters edit mode.

NAMING

LOCAL (1)	Creates a local variable.
MAKE (2)	Makes the second input be the value of the first input (variable).
THING (1)	Returns the value of the variable named by the input (word).
THING? (1)	Returns TRUE if its input has a value associated with it.

CONDITIONALS

ALLOF (2)*		Returns TRUE if all inputs are true.
ANYOF (2)*		Returns TRUE if any input is true.
ELSE		Used IF . . . THEN . . . ELSE.
IF		Tests a condition.
MEMBER? (2)		Accepts two inputs and returns TRUE if the first is a member of the second.
EMPTY? (1)		Returns TRUE if the input is an empty word or list.
IFFALSE	IFF	Executes remainder of line only if preceding TEST was FALSE.
IFTRUE	IFT	Executes remainder of line only if preceding TEST was TRUE.
NOT (1)		Returns FALSE if input is TRUE, TRUE if input is FALSE.
TEST (1)		Tests a condition for use with IFFALSE and IFTRUE.
THEN		Used with IF . . . THEN . . . ELSE.

CONTROL

GO (1)		Transfers control to a line with that label.
GOODBYE		Clears workspace and restarts Logo.
OUTPUT (1)	OP	Causes the current procedure to stop and return the input to the calling procedure.
REPEAT (2)		Accepts a number and a list. The list is executed the designated number of times.
RUN (1)		Runs the input list as if it had been typed as a series of Logo commands.
STOP		Current procedure stops and returns control to the calling procedure.
TOPLEVEL		Stop all procedures and returns to toplevel.

INPUT AND OUTPUT

OUTDEV (1)	Designates an output device.
ASCII (1)	Returns the ASCII code of the input character.
CHAR (1)	Returns the character corresponding to the input ASCII number.
CLEARTEXT	Clears the textscreen and homes the cursor.
CLEARINPUT	Clears the character input buffer.
CURSOR (2)	Moves the cursor to the input row and column position.
PADDLE (1)	Returns a number 0-255 describing the position of the input paddle number.
SHOWTEXT	Prints the contents of the edit buffer to the current output device.
PADDLEBUTTON (1)	Returns TRUE or FALSE indicating the state of the input paddlebutton number.
PRINT (1)*	PR Prints the input on the screen.
PRINT1 (1)*	Prints the input on the screen. Doesn't terminate with a return.
RC?	Returns TRUE if a character is already available from the keyboard.
READCHARACTER	RC Returns character from keyboard, waiting for character input if necessary.
REQUEST	RQ Waits for an input line terminated with a return.
SETDISK (2)***	Directs file commands to the specified Slot/Drive and optionally Volume.

FILING AND MANAGING WORKSPACE

CATALOG		Prints the names of the files on the currently mounted disk.
DOS (1)		Accepts Apple DOS commands.
ERASEFILE (1)		Erases specified file from the disk.
ERASEPICT (1)		Erases specified picture from the disk.
PRINTOUT **	PO	Lists the specified procedure(s) on the screen.
POTS		Lists all procedure names in memory.
READ (1)		Reads a file from disk.
READPICT(1)		Reads a picture file from disk.
SAVE (1)***		Saves the contents of the workspace on disk.
SAVEPICT (1)		Saves the picture on the screen.

DEBUGGING

CONTINUE	CO	Resumes execution after a PAUSE or ⟨CTRL⟩Z.
PAUSE	⟨CTRL Z⟩	Stops program execution.
NOTRACE		Turns off tracing.
TRACE		Causes Logo to pause before executing each procedure.

MISCELLANEOUS COMMANDS

.ASPECT (1)	Changes the vertical scale at which Logo graphics are drawn.
.BPT (1)	Returns control to the Apple monitor.
.CALL (2)	Calls a machine language subroutine.
.CONTENTS	Returns a list of all words known to Logo.
.DEPOSIT (2)	Places one byte of data in a specified memory location.
.EXAMINE (1)	Returns the value of the byte at the specified address.
.GCOLL	Forces garbage collection.
.NODES	Returns the number of currently free nodes.
;	Causes the rest of line not to be evaluated. Useful for including comments in procedures.

( ) Number of inputs.

* Takes a variable number of inputs and operates on all of them.

** Takes unquoted inputs. See technical manual.

*** Takes a variable number of inputs and performs special actions. See technical manual.

NINETY -

Terrapin, Inc. (hereinafter referred to as against defects in material and workma purchase. Products manufactured by T trademarks, trade name, or logo affixed

During the warranty period, Terrapin w defective, provided the Terrapin produ authorized Terrapin distributor.

You may request information on how at the address above. Your sales rec purchase (such as bill of sale or canc warranty replacement.

This warranty does not apply if, in the accident, misuse, missapplication, o an authorized Terrapin distributor.

Other Terrapin Logo Commands

NUMERIC OPERATIONS

+	Addition.
-	Subtraction.
*	Multiplication.
/	Division.
>	Greater than.
<	Less than.
ATAN (2)	Returns the arctangent of the quotient of two inputs.
COS (1)	Returns cosine.
INTEGER (1)	Truncates the fractional part of a number.
NUMBER? (1)	Returns TRUE if input is a number.
QUOTIENT (2)	Returns the integer quotient of two inputs.
RANDOM (1)	Returns a repeatable sequence of random numbers.
RANDOMIZE (0)* * *	Varies the input seed for random.
REMAINDER (2)	Returns the integer remainder.
ROUND (1)	Returns the nearest integer.
SIN (1)	
SQ	

W

= [ ]

BU

BU

CO

FIR

FPU

ITE

Serial # 6925

RD

ed to Terrapin to insure

se Date

ER

State

Terrapin

e Terrapin™ Logo Language
the Apple® II
nguage Disk

n, Inc., 1982, 1983, 1984, 1985,
1980, 1981

64K and 128K
Versions

№ 69251

go Commands

e quotient of

a number.
er.
o inputs.

CHAPTER I, ECIA
McDONALD CO. R-1 SCHOOLS

The
Original
Logo
People

Terrapin

1987 Catalog

Terrapin Logo for the Macintosh

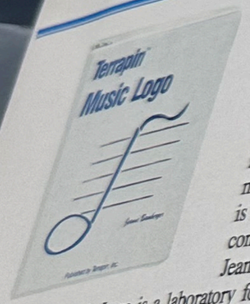
Logo and the power of the Macintosh.

Terrapin™ Logo for the Macintosh™ combines the most popular features of Terrapin Logo for the Apple II and Commodore 64 with the power and ease of use of the Macintosh. It provides more workspace, is considerably faster and uses the standard interface of windows and pull-down menus. Plus, each graphics window supports multiple turtles, creating a new dimension in Logo programming. Advanced features include multi-dimensional arrays, strings, extended CATCH and THROW, stream I/O, property lists, automatic load-on-call and much more.

Terrapin Logo for the Macintosh runs on any Macintosh or Macintosh Plus with 512K or more. Comes complete with Tutorial and Reference Guide.

Terrapin Logo for the Macintosh	$ 79.95
MacPak-10 (10 Disks)	$399.95
MacPak-20 (20 Disks)	$699.95

Terrapin Music Logo



Music for everyone!

A new set of music primitives replaces the graphics portion of the Logo language to bring you Terrapin™ Music Logo. The result is a unique toolkit for composing in six voices simultaneously—in a truly procedural environment. And, being an extensible language, Logo is ideally suited for you to explore music concepts. Developed in conjunction with Jeanne Bamberger, well-known music theorist from MIT, Music Logo is a laboratory for experimentation in musical perception, intended for a wide spectrum of users. Terrapin Music Logo runs on the Apple II family of computers in 64K. Comes complete with comprehensive Sourcebook, Music Logo Language disk with backup, and Projects disk.

(An ALF synthesizer board, game paddles, amplifier and speakers (or home stereo) are required. Ordering information for ALF board is included with package.)

Terrapin Music Logo	$ 99.95

ORDER FORM

Item / Title	Unit Price	Total
	Sub Total	
5% Sales Tax (MA residents only)		
Shipping (See **Shipping Charges** section)		
Total Amount		

SHIPPING CHARGES:
Terrapin Logo for the Apple, Tutorials, Terrapin Music Logo and Terrapin Logo for the Macintosh: U.S. orders, add $5.00. Canadian orders, add $6.00. Overseas orders, add $7.00 per unit.
Commodore Logo, Logo Data Toolkit and books in the Logo Works series: U.S. and Canadian orders add $2.50 for first item, $1.00 each additional. Overseas orders, add $6.00 for first item, $1.00 each additional.
No shipping charge for Backup disk, Utilities II Package, Demo Kit, upgrades or trade-ins.

FREIGHT:
All prices FOB Cambridge, MA, USA. U.S. orders sent via UPS, Canadian via U.S. mail, overseas orders via surface parcel post, unless otherwise requested.

CREDIT:
Purchase orders accepted for amounts over $30.00 from U.S. and Canadian schools (excluding upgrades and trade-ins). Other orders should be prepaid or C.O.D. (U.S. only). All overseas orders must be prepaid. Telex for bank wire information. Credit terms: Net 30. All prices subject to change without notice.

Send to _____

Address _____

_____

City _____ State _____ Zip _____

Phone _____

Charge Card Information: MC VISA (circle one)

Card # _____ Exp. Date _____

Signature _____

errapin

o.

four
the Logo Data
anipulate and
d to meet your

es and things
ports

ttitudes
friends
f the results

ted data
ect areas

collected data

nters

oughout the
room activity
projects
fic areas of
ta conversion
e provided.
lore Logo.

$ 49.95
$ 49.95

rrapin Logo Commands

ATIONS

Addition.
ubtraction.
ltiplication.
ion.
er than.
an.
the arctangent of the quotient of
s.
sine.
e fractional part of a number.
E if input is a number.
eger quotient of two inputs.
table sequence of

ed for random.
remainder.
nteger.

4K and 128K
Versions
69251

Why Choose Terrapin Logo Products?

Because Terrapin Logo is simply the best Logo available for both home and classroom use. Terrapin Logo motivates learning by stressing the active role of the student in the learning process, so that "the student teaches the computer." Terrapin is also committed to providing the support you need, through excellent supplementary materials and unmatched customer service.

The Terrapin Logo Language has evolved over more than 12 years, and has been modified through extensive testing with students and teachers. In recent years, Logo has become the predominant microcomputer language used in elementary schools across the nation. It is also gaining worldwide popularity among educators at all levels. More than 175,000 copies of Terrapin Logo are in use in schools, computer clubs and homes worldwide.

Terrapin Logo encourages you to question and explore by providing an active, hands-on problem solving environment. The simple syntax makes it easy for beginners to get started. And, Logo has the flexibility to allow students to explore complex ideas without needing advanced programming skills.

Logo is best known for turtle graphics, the capability to "drive" a turtle (triangular cursor) around the screen. This intuitive and easily grasped way of creating graphics encourages experimentation. Turtle graphics makes mathematics, and particularly geometry, come alive. And, Logo's words and lists commands make Terrapin Logo a superb tool for exploring language as well.

Terrapin continues to publish a growing set of products to ensure your success with Logo year after year. The Logo Works™ series of curriculum support materials integrates Logo into the classroom curriculum, and the all new Logoware™ series of Logo-based applications extends Logo into a number of different subject areas.

With award-winning tutorials, lab packs, networked versions and district pricing arrangements, you can be sure Terrapin products are the best value for your money. And, it's good to know that Terrapin's unsurpassed customer support staff is always available to answer your questions and assist you in any way.

At Terrapin, we realize the important role Logo plays in meeting the needs of educators and students, and we stand committed to supporting and extending Logo's virtually endless applications—through research, modification and development.

Terrapin™
The Logo People
Terrapin, Inc., 222 Third St.
Cambridge, MA 02142 (617) 492-8816

Terrapin, Logo Works and Logoware are trademarks of Terrapin, Inc., Commodore is a trademark of Commodore Business Machines, Inc. Apple is a registered trademark of Apple Computer, Inc., Macintosh is a trademark of Apple Computer, Inc.

Congratulations!

You have just purchased the new 3.0 Release of the Terrapin Logo Language for the Apple II family of Computers. Your Logo Language disk contains both 64K and 128K versions. The correct version will be loaded depending on the machine being used. This loading technique is automatic and requires no special input from the user. In addition, loading time is significantly less than in earlier versions.

For those using 128K systems, there have been no functional changes to the Terrapin Logo Language other than the additional memory now available in your workspace. A few points worth mentioning before using the new dual version are as follows:

* You will notice that garbage collection requires more time when 128K is being used due to the increased workspace.

* 128K Logo has approximately three times more storage space available to the user. The error message "NO STORAGE LEFT!" will not appear as frequently, if at all.

* Entering the editor does not affect the contents of the graphics screen.

* Using the Logo command DRAW does not affect the contents of the editor.

Commands

t of

New Logo Primitive for Version 3.0: SHOWTEXT

*Terrapin has created a new Logo primitive for version 3.0 known as **SHOWTEXT**. This primitive can be used when creating text files in Logo and using Logo as a text editor. Refer to pages A-26 to A-29 in the Appendix and Chapter 7 of the technical manual for further information on creating text files.*

SHOWTEXT *Prints the contents of the edit buffer to the current output device, which is normally the video screen. Use OUTDEV to redirect output to a printer.*

NOTE: *This new primitive is not documented elsewhere in the manual.*

The Terrapin Logo Language for the Apple II

TUTORIAL

CHAPTER I, ECIA
McDONALD CO. R-1 SCHOOLS

© TERRAPIN
© LOGO LANGUAGE

thereof for foreign publications or publication in other than the English language, apply to the Copyright owner or publisher. Publication pursuant to any permission shall contain an acknowledgment of this copyright and an acknowledgment and disclaimer statement as follows:

This material was prepared with the support of National Science Foundation Grant No. SED-7919033. However, any opinions, findings, conclusions, or recommendations expressed herein are those of the authors and do not necessarily reflect the views of the NSF.

Each school purchasing and putting into use Logo will make the program object code and accompanying manuals and teaching guides, if any, available for inspection by the parents or guardians of the children who will be using Logo in the school.

Copyright © 1982, 1983 Terrapin, Inc.
222 Third Street
Cambridge, MA 02142
(617) 492-8816

Terrapin hereby grants permission in advance to copy the computer programs listed in the documentation and on the utilities disk, for personal and archival purposes only.

Terrapin expressly reserves all rights including without limitation copyright and trademark, in and to the Terrapin Logo mascot figures as represented herein, or from any other perspective.

Terrapin, the Terrapin logo, and the Terrapin mascots re trademarks of Terrapin, Inc.

pple and Silentype are registered trademarks of ple Computer, Inc.

eferences to "Logo" herein refer to the Logo lan-e, developed at the Massachusetts Institute of ology.

CONTENTS

BEGINNING IN LOGO

Your Terrapin Logo Package B-1
This Tutorial B-2

Overview: What Can You Do With Logo? B-3
Graphics B-4
Computation B-5
Words and Lists B-5
Music B-6

Preparing a Blank Disk For Use B-6
Starting Logo B-8

When Logo Has Started Up B-11
Recovery Process B-12

Using the Keyboard B-13
Upper Case and Lower Case B-15
Starting Logo: Summary B-16

GRAPHICS

Graphics Mode G-1
Driving the Turtle: FORWARD (FD), BACK (BK), RIGHT (RT), LEFT (LT) G-2
Let Logo Do Your Arithmetic G-5
An Easy Way to Repeat Yourself: <CTRL> P G-5

The Screen: DRAW, NODRAW (ND), TEXTSCREEN (<CTRL> T), SPLITSCREEN (<CTRL> S), FULLSCREEN (<CTRL> F) G-7
Turtle-driving Projects G-8
Color: PENCOLOR (PC) and BACKGROUND (BG) G-8
The Magic of PENCOLOR 6: Erasing G-11

Introduction to Procedure Writing G-12

er Terrapin Logo Commands

C OPERATIONS

Addition.
Subtraction.
Multiplication.
Division.
Greater than.
Less than.
Returns the arctangent of the quotient of two inputs.
Returns cosine.
Truncates the fractional part of a number.
eturns TRUE if input is a number.
turns the integer quotient of two inputs.
urns a repeatable sequence of
om numbers.
the input seed for random.
s the integer remainder.
the nearest integer.

64K and 128K Versions

Nº 69251

Primitives vs. Procedures G-12
Naming a Procedure G-13
Writing a Procedure: EDIT Mode: TO, END, <CTRL> C, <CTRL> G G-14
Running a Procedure G-19

Planning and Drawing Your Favorite Square G-21
Projects: Simple Procedures G-25
What goes Into a Procedure G-25
More Primitives: REPEAT, CLEARSCREEN (CS), HOME, PENUP (PU), PENDOWN (PD) G-26
Procedure Projects G-28

Saving Procedures: CATALOG, SAVE, POTS G-29
Clearing the Workspace, Reloading Procedures: READ, ERASE (ER), ERASE ALL (ER ALL), GOODBYE, ERASEFILE G-32
Selective Uses of SAVE, PO, ERASE (ER), and EDIT (ED) .. G-34
Saving, Reading and Erasing Pictures: SAVEPICT, READPICT, ERASEPICT G-35

The Invisible Turtle: HIDETURTLE (HT), SHOWTURTLE (ST) G-37
Summary of Logo Commands Used So Far G-38
More About the Editor: <CTRL> P, <CTRL> N, <CTRL> O, <CTRL> A, <CTRL> E, <CTRL> D, <CTRL> X, <CTRL> Y G-40
Summary of Editing Commands G-41

Projects Using Shapes G-42
Listing a Procedure: PRINTOUT (PO), PO ALL, <CTRL> W G-43
Summary of Listing Commands G-44
Heading: A Matter of State G-44
Copying a Procedure G-46

A Magic Number G-46
Projects: More Shapes G-48

Introduction to Variables: Procedures That Take Inputs ... G-48
Projects: Sizable Shapes G-53
From SQUARE to POLY G-53
Projects: Regular Polygons G-55
Another View of POLY G-55

Circles G-57
Projects: Curves G-57
Using Subprocedures G-58

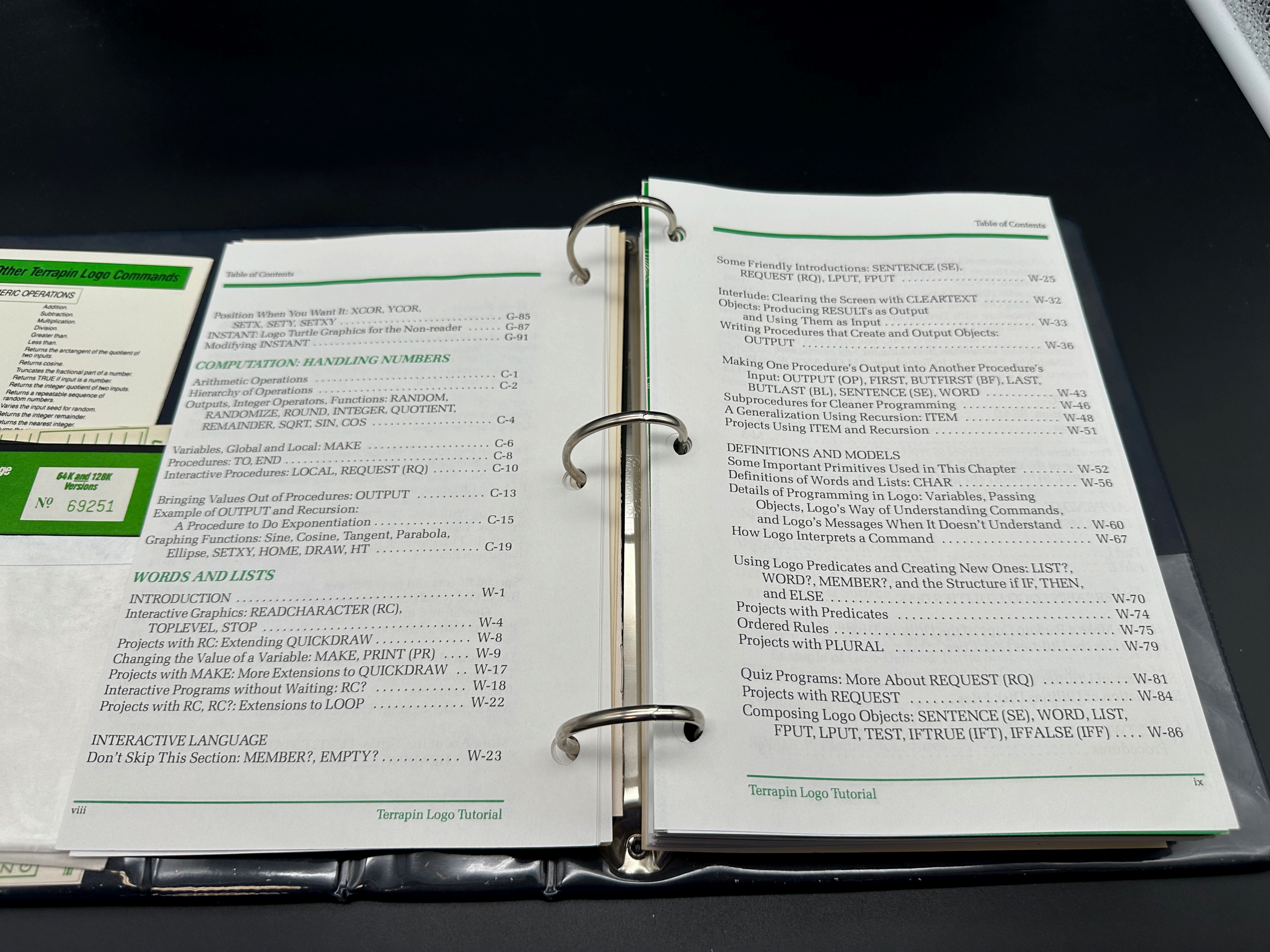
Non-stop Procedures: Introduction to Recursion G-61
Projects: Simple Recursion G-62
Recursion: Changing the Input, WRAP, NOWRAP G-62
Projects: Changing Inputs G-65

Stopping With Style: IF-THEN, STOP G-66
Projects: Testing and Stopping G-69
Using the Full Power of Recursion G-69
Recursion Projects G-73

Special Effects and New Utilities G-74
RANDOM Numbers, Numbers from Arithmetic Operations, Inputs, Outputs G-76
Projects Using Random G-78

Debugging by Printing Values: PRINT (PR) G-79
Debugging Using PAUSE: <CTRL> Z, CONTINUE (CO) .. G-81
Negative Inputs G-81
More on Debugging: TRACE, NOTRACE G-83

More About the Turtle: TURTLESTATE (TS), HEADING, SETHEADING (SETH), TOWARDS G-83



Position When You Want It: XCOR, YCOR, SETX, SETY, SETXY G-85
INSTANT: Logo Turtle Graphics for the Non-reader G-87
Modifying INSTANT G-91

COMPUTATION: HANDLING NUMBERS

Arithmetic Operations C-1
Hierarchy of Operations C-2
Outputs, Integer Operators, Functions: RANDOM, RANDOMIZE, ROUND, INTEGER, QUOTIENT, REMAINDER, SQRT, SIN, COS C-4

Variables, Global and Local: MAKE C-6
Procedures: TO, END C-8
Interactive Procedures: LOCAL, REQUEST (RQ) C-10

Bringing Values Out of Procedures: OUTPUT C-13
Example of OUTPUT and Recursion: A Procedure to Do Exponentiation C-15
Graphing Functions: Sine, Cosine, Tangent, Parabola, Ellipse, SETXY, HOME, DRAW, HT C-19

WORDS AND LISTS

INTRODUCTION W-1
Interactive Graphics: READCHARACTER (RC), TOPLEVEL, STOP W-4
Projects with RC: Extending QUICKDRAW W-8
Changing the Value of a Variable: MAKE, PRINT (PR) W-9
Projects with MAKE: More Extensions to QUICKDRAW W-17
Interactive Programs without Waiting: RC? W-18
Projects with RC, RC?: Extensions to LOOP W-22

INTERACTIVE LANGUAGE
Don't Skip This Section: MEMBER?, EMPTY? W-23

Some Friendly Introductions: SENTENCE (SE), REQUEST (RQ), LPUT, FPUT W-25

Interlude: Clearing the Screen with CLEARTEXT W-32
Objects: Producing RESULTs as Output and Using Them as Input W-33
Writing Procedures that Create and Output Objects: OUTPUT W-36

Making One Procedure's Output into Another Procedure's Input: OUTPUT (OP), FIRST, BUTFIRST (BF), LAST, BUTLAST (BL), SENTENCE (SE), WORD W-43
Subprocedures for Cleaner Programming W-46
A Generalization Using Recursion: ITEM W-48
Projects Using ITEM and Recursion W-51

DEFINITIONS AND MODELS
Some Important Primitives Used in This Chapter W-52
Definitions of Words and Lists: CHAR W-56
Details of Programming in Logo: Variables, Passing Objects, Logo's Way of Understanding Commands, and Logo's Messages When It Doesn't Understand W-60
How Logo Interprets a Command W-67

Using Logo Predicates and Creating New Ones: LIST?, WORD?, MEMBER?, and the Structure if IF, THEN, and ELSE W-70
Projects with Predicates W-74
Ordered Rules W-75
Projects with PLURAL W-79

Quiz Programs: More About REQUEST (RQ) W-81
Projects with REQUEST W-84
Composing Logo Objects: SENTENCE (SE), WORD, LIST, FPUT, LPUT, TEST, IFTRUE (IFT), IFFALSE (IFF) W-86

An Application of LPUT in Interactive Graphics: RUN W-94
Using the History List: Applying a Command to Each Element of a List W-96
Projects with History Lists W-99
Substituting One Word for Another in a Sentence: A Procedure with Two Recursive Calls W-100
Projects with Mad-Libs W-105

Understanding Language: Searching for Key Words and Matching Sentences to Templates: ALLOF, ANYOF . . W-106
Projects with Language Understanding W-115

MUSIC
Preparation: READ M-1
Duration M-2
Pitch M-5
Procedures M-7
Analyses of the Utilities Disk Music Procedures: STOP, FIRST, BUTFIRST (BF), THING, WORD, Top Level . . . M-11

APPENDIX
ERROR MESSAGES A-1

Part I A-1
Part II A-5

THE TERRAPIN LOGO UTILITIES DISK A-13

How to Make a Backup Copy of the Utilities Disk A-13
How to Use the Utilities Disk Files A-13

Summary of Utilities Disk Files A-14
Explanation of Utilities Disk Files A-18

MUSIC, TWINKLE: How to Write and Run Logo Music Procedures A-18

MUSIC.BIN, MUSIC.SRC: An example of Logo/Assembler Interfacing A-18

INSTANT: Single Letter Logo Commands A-19
TEACH: How to Write Logo Procedures Without Using the Editor. A-19

ARCS: Variable Radii Arc and Circle Procedures A-21
CURSOR: Procedures for Character Output Control: Position, Flashing, Inverse A-23

How to Print Text Into Disk Files: Directly and Using DPRINT A-24
TEXTEDIT: How to Save, Read, Examine, and Print Text Files A-26

FID: File Management Utility: How to Delete, Rename, Lock, and Unlock files, Set Default File Extension A-29
SCREENDUMP: Printing the Logo Graphics Screen A-29
SHAPE.EDIT: How to Change the Shape of the Turtle A-30

ANIMAL: The Game that Teaches the Computer About Animals A-30
ANIMAL.INSPECTOR: What's in the ANIMAL Knowledge Base? A-31
DYNATRACK: A Game: the Dynamic Turtle on a Frictionless Surface A-32

INSPI.PICT: Sample Logo Picture A-33
ROCKET, ROCKET.AUX, ROCKET.SHAPES: Example of User-Defined Turtle Shape A-33
TET: A Graphics Procedure of Variable Complexity A-34

ADDRESSES, AMODES, ASSEMBLER, OPCODES: Interfacing Logo and the Assembler A-35
SWEET-P: Plotter Procedures A-35

her Terrapin Logo Commands

RIC OPERATIONS

Addition.
Subtraction.
Multiplication.
Division.
Greater than.
Less than.
Returns the arctangent of the quotient of two inputs.
Returns cosine.
Truncates the fractional part of a number.
Returns TRUE if input is a number.
Returns the integer quotient of two inputs.
Returns a repeatable sequence of random numbers.
aries the input seed for random.
turns the integer remainder.
urns the nearest integer.

64K and 128K Versions

No 69251

Table of Contents

RSPLOTTER: Procedures for the Radio Shack Plotter A-36

EDIT MODE A-38

Use of Control Characters for Ease in Editing A-38
Moving the Cursor A-38
Moving the Text A-39
Deleting Text A-40
Leaving EDIT Mode A-41

PROCEDURES
GRAPHICS CHAPTER
Turtle Driving Projects A-42
Procedure Projects A-45
Projects Using Shapes A-48
Projects: More Shapes A-62
Projects: Sizable Shapes A-63
Projects with Regular Polygons A-65
Projects: Curves A-68
Projects: Simple Recursion A-71
Projects: Changing Inputs A-73
Projects: Testing and Stopping A-77
Recursion Projects A-79
Projects Using Random A-89
Mascots: Elephant, Rabbit, Snail A-92
Procedures for Saving Pictures A-96
Developing an Arc Procedure A-99
Debugging with TRACE, NOTRACE A-102
Adding Remarks in Your Procedures A-103
Switching Disk Drives: SETDISK A-103
Creating Self-Starting Files
Using the STARTUP Variable A-104

STRATEGIES FOR THE WORDS
AND LISTS PROJECTS A-105

INDEX

BEGINNING IN LOGO

apin Logo Commands

TIONS

dition.
fraction.
plication.
n.
than.
n.
e arctangent of the quotient of
ine.
fractional part of a number.
if input is a number.
ger quotient of two inputs.
table sequence of
ed for random.
remainder.
integer.

64K and 128K Versions

69251

B BEGINNING IN LOGO

Your Terrapin Logo Package

NOTE: This section should be read the first time you use your Logo package. If you have used Terrapin Logo before, or have a resource person or teacher helping you, skip to the next section, titled This Tutorial.

In your Terrapin Logo package, you will find:

1 Logo Language disk
1 Utilities Disk containing demonstration and utility programs
1 Documentation Manual containing
  1 Terrapin Logo Tutorial, which you are now reading, and
  1 Technical Manual

In order to use Logo, you will also need:

An Apple II+ (or Apple II) with 48K of RAM, and a 16K memory card such as the Apple Language Card, Microsoft, MPC, or Davong RamCard
  or
An Apple IIe or IIc
  or
An Apple-compatible computer
One disk drive, with controller

To save your work, you will need a blank disk.

Before using your Utilities Disk, you should make a backup copy because it is possible to damage or erase the Utilities Disk accidentally.

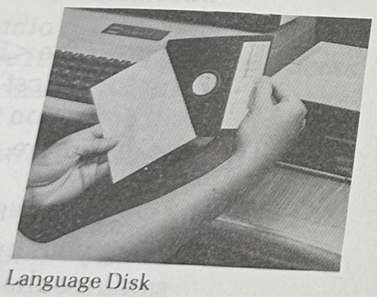
Remove this disk from the disk drive, label it immediately, and use it to store your Logo procedures. We will refer to it again in the section When Logo Has Started Up later in this chapter.

More information about initializing disks is in the Logo Technical Manual in the File System section titled Configuring File Diskettes (page 23) and in the Apple DOS manual, page 13. BASIC programs and Logo procedures can be stored on the same disk.

Starting Logo

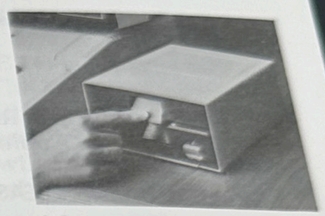
One of the disks packaged with your system is called the Language Disk. It is the disk with the Logo interpreter on it. The other disk, labeled Utilities Disk contains some demonstration and utility programs. They are mentioned where appropriate in the tutorial and summarized and cross-referenced in the Appendix.

Apple II Plus with Disk Drive and Monitor



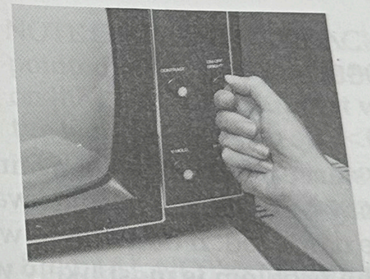
Language Disk

(1)

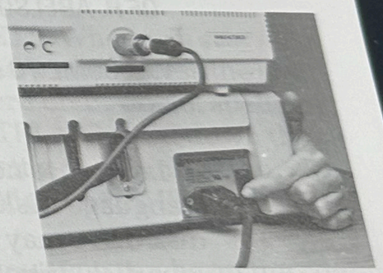


(2)

With the Apple turned off, (1) place the Language Disk in your disk drive with the label facing up and closest to the front. (2) Close the disk drive door firmly. (3) Turn on the monitor. (4) Turn on the Apple. The on-off switch is on the back at the left as you face the machine. (Users of Apple IIs without AutoStart ROM should (A) press <RETURN>, (B) type the number 6, (C) hold down the <CTRL> key and press P, and (D) press the <RETURN> key again.)



(3)



(4)

STARTING LOGO: SUMMARY

1. *Place Language Disk in disk drive.*
2. *Turn on Apple; wait approximately 30 seconds while Logo is loaded.*
3. *After WELCOME TO LOGO is printed, remove the Language Disk. Insert your storage disk.*
4. *You are ready to proceed with Logo.*

GRAPHICS

Logo Commands

of the quotient of

rt of a number.
umber.
of two inputs.
e of

COMPUTATION: HANDLING NUMBERS

The general formula for an ellipse is

$$(X-H) * (X-H) / (A * A) + (Y-K) * (Y-K) / (B * B) = 1$$

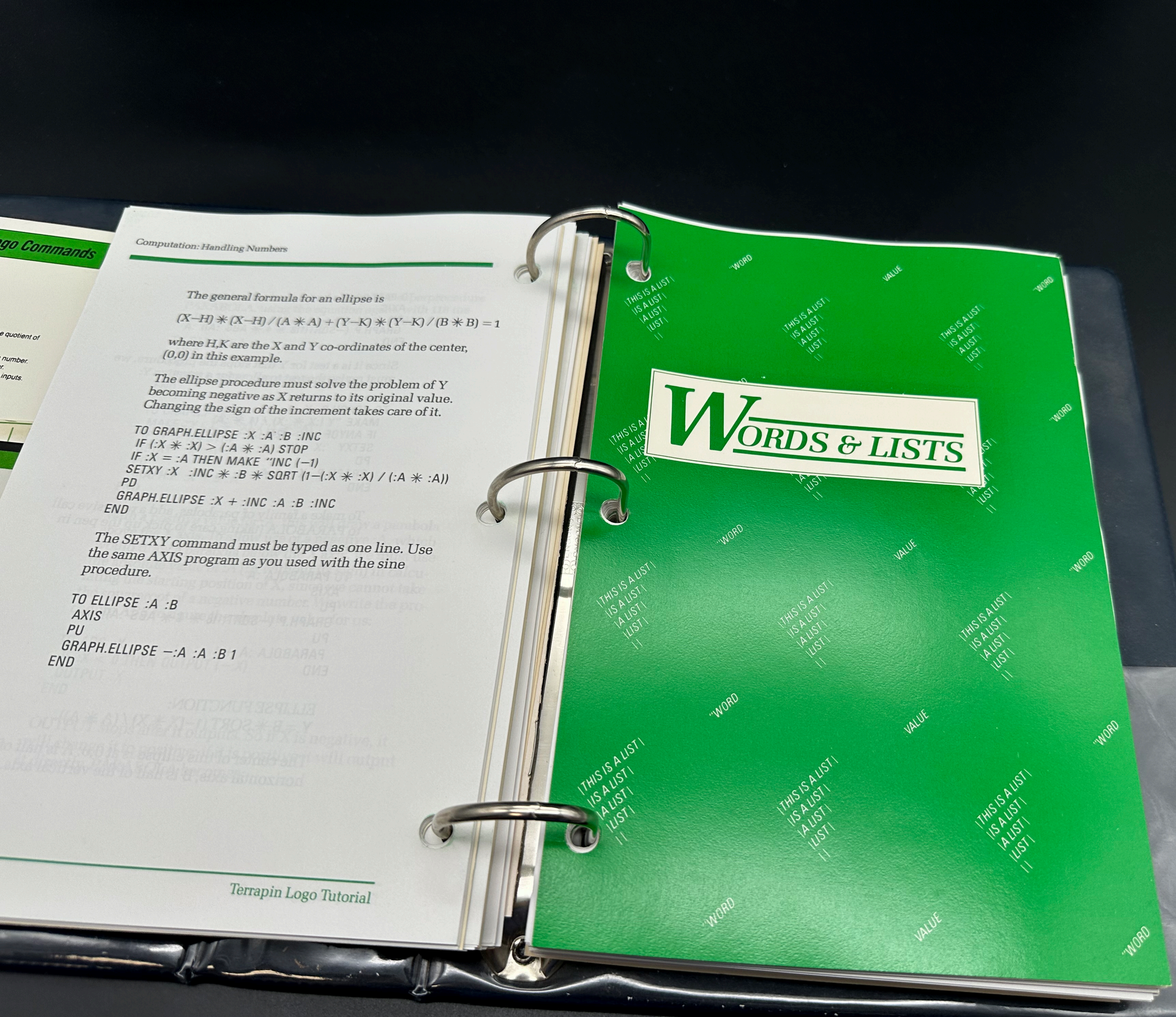
where H,K are the X and Y co-ordinates of the center, (0,0) in this example.

The ellipse procedure must solve the problem of Y becoming negative as X returns to its original value. Changing the sign of the increment takes care of it.

```
TO GRAPH.ELLIPSE :X :A :B :INC
IF (:X * :X) > (:A * :A) STOP
IF :X = :A THEN MAKE "INC (-1)
SETXY :X  :INC * :B * SQRT (1-(:X * :X) / (:A * :A))
PD
GRAPH.ELLIPSE :X + :INC :A :B :INC
END
```

The SETXY command must be typed as one line. Use the same AXIS program as you used with the sine procedure.

```
TO ELLIPSE :A :B
AXIS
PU
GRAPH.ELLIPSE -:A :A :B 1
END
```

39. Finally, fix the program not to get stumped by punctuation.

40. As CHECK is currently written, [MY NAME IS @NAME] would match [MY NAME IS ASHER] but would not match [MY NAME IS ASHER LEV] because only one word can match a wild card.

Likewise, [@JUNK CALL ME @NAME] would not match [CALL ME ISHMAEL], because some word must be present to match @JUNK.

A better CHECK program would recognize two kinds of wild cards, one that matches to exactly one word in the sentence (the situation we already have), and another that matches to any number of words in the sentence, including 0.

The new wild card would have to be symbolized differently, perhaps by a number-sign prefix. So CHECK would be able to tell that both CALL ME ISHMAEL and MY CLOSE FRIENDS CALL ME SIR OLIVER match the template [#JUNK CALL ME #NAME], but that [MY NAME IS HARRIET BEECHER STOWE] fits another template.

MUSIC

Line 3: Runs the procedure .CALL.2 using the following for inputs:
For :ADDR—the value of the global variable :TONE (defined by SETUP)
For :INPUT1—the value of the local variable :PERIOD
For :INPUT2—a value obtained by the calculation shown

Harmony: The Terrapin Music System

The Terrapin Music System, available separately, gives the user the ability to create 6-part harmony over a six-octave range, as well as some rhythm sounds. The Music System uses the techniques described in this tutorial, plus primitives and procedures for putting the voices together.

APPENDIX

To increase the resolution of the picture, really only desirable when you are going to print a design on paper, decrease the size of the step. Replace the original 1 with :STEP and add the variable to the title.

To keep our procedure drawing arcs with the specified radius, we must multiply the turn by the :STEP and consequently, divide the number of turns by :STEP, giving us (name changed to avoid confusion with the non-variable step version):

Type as one line

```
TO RARC :RADIUS :DEG :STEP
REPEAT (.0174532 * :DEG * :RADIUS)/:STEP
 [FD :STEP RT (57.295827 * :STEP) /:RADIUS]
END
```

Debugging with TRACE, NOTRACE

TRACE allows you to watch the execution of your procedure line by line. Logo prints a statement, waits for you to type a character, then executes the statement. TRACE also tells you when it is starting a subprocedure, and tells you what the inputs are.

In TRACE mode, type <CTRL> G, as usual, to stop a procedure. <CTRL> Z will make it PAUSE; type CO (or CONTINUE) to resume. Type NOTRACE to stop tracing.

TRACE and NOTRACE may be used in a procedure to trace just a portion of it.

Adding Remarks in Your Procedures

When you use descriptive procedure names and variable names, and write short procedures and subprocedures, your need for remarks throughout your procedures is lessened, and in many cases, eliminated.

However, for those remarks that simply must go in, precede them with a semi-colon (;) as in the (not to be taken seriously as an) example:

```
TO SQUARE
FD 100;GOES FORWARD 100
RT 90;GOES RIGHT 90
SQUARE;CALLS ITSELF
END
```

Switching Disk Drives: SETDISK

Occasionally you may want to use more than one disk drive in your Logo system. Use the SETDISK command to switch back and forth between drives. SETDISK takes two inputs, a drive number and a slot number, and causes all subsequent file operations to be done in that drive. For example, SETDISK 2 6 transfers control to the second drive in a two-drive system. Default is SETDISK 1 6.

```
TO SQUARE
FD 100;GOES FORWARD 100
RT 90;GOES RIGHT 90
SQUARE;CALLS ITSELF
END
```

Switching Disk Drives: SETDISK

Occasionally you may want to use more than one disk drive in your Logo system. Use the SETDISK command to switch back and forth between drives. SETDISK takes two inputs, a drive number and a slot number, and causes all subsequent file operations to be done in that drive. For example, SETDISK 2 6 transfers control to the second drive in a two-drive system. Default is SETDISK 1 6.

It is possible to write Logo files which
immediately after being read into the wo
There is an interesting way of doing this using th
dress SAVMOD found in the ADDRESSES file (see sec-
tion 7.2 of the Technical Manual); however, this way is
also rather difficult.

A much easier way to create self-starting files is to use
a STARTUP variable. Simply include in the file a
global variable consisting of a list of the procedure to
be started automatically. For example, if Logo encoun-
ters the message

```
MAKE "STARTUP [DEMO]
```

while reading in a file, the procedure DEMO will begin
automatically.

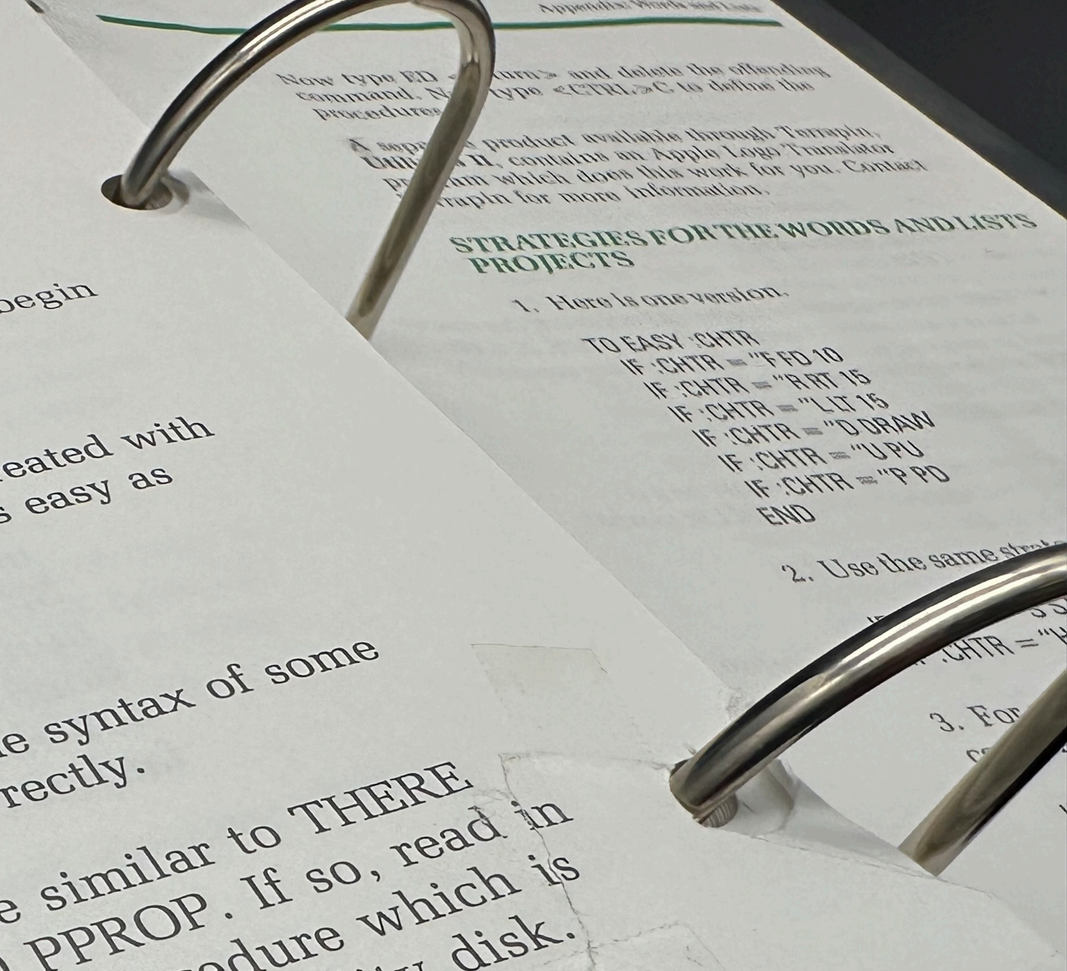
Reading Apple Logo Files

Using Terrapin Logo, you can read files created with
Apple Logo from Apple Computer. It's as easy as
typing

```
READ "FILENAME
```

Of course, you will need to alter the syntax of some
procedures to make them run correctly.

You may encounter a message similar to THERE
IS NO PROCEDURE NAMED PPROP. If so, read in
the file using the READTEXT procedure which is
found in the TEXTEDIT file on the Utility disk.



rapin Logo Comman

TIONS

dition.
traction.
iplication.
on.
r than.
an.
the arctangent of the quotient of
s.
sine.
e fractional part of a number.
IE if input is a number.
teger quotient of two inputs.
atable sequence of
s.
seed for random.
er remainder.
t integer.

64K and 128
Versions

692

L O G O

for the Apple II

TECHNICAL MANUAL

Terrapin, Inc.
222 Third Street
Cambridge, Massachusetts 02142
(617) 492-8816

Copyright © 1982, 1983, 1984 Terrapin, Inc.
Copyright © 1981 Massachusetts Institute of Technology

Table of Contents

1. Preparing to Use Logo 3
1.1. Configuration 3
1.2. The Keyboard 3
1.3. Loading and Starting Logo 5
1.3.1. On Apples with Autostart ROM 5
1.3.2. On Apples without Autostart ROM 6
1.4. Bugs in the Logo System 6

2. Use of the Logo System 9
2.1. Modes of Using the Screen 9
2.1.1. Nodraw Mode 9
2.1.2. Edit Mode 9
2.1.3. Draw Mode 10
2.2. Editing 12
2.2.1. Line Editor 13
2.2.2. Screen Editor 13
2.3. Using Apple Peripherals 16
2.3.1. Printing Procedures on a Printer 17
2.3.2. Printing Pictures 18
2.4. Color Control 20
2.4.1. Drawing on Colored Backgrounds 20
2.4.2. Drawing without Color Control 21
2.5. The Logo File System 21
2.5.1. Disk Files 22
2.5.2. Saving Pictures 23
2.5.3. Configuring File Diskettes 23

3. Logo System Primitives 25
3.1. Graphics Commands 25
3.2. Numeric Operations 28
3.3. Word and List Operations 29

3.4. Defining and Editing Procedures 31
3.5. Naming 33
3.6. Conditionals 33
3.7. Control 34
3.8. Input and Output 36
3.9. Filing and Managing Workspace 38
3.10. Debugging 39
3.11. Miscellaneous Commands 40

4. The Utilities Disk 43

4.1. Program Descriptions 44
4.1.1. Demonstration Programs 49

5. Changing the Turtle Shape 53

6. Assembly Language Interfaces to Logo 59

6.1. .EXAMINE and .DEPOSIT 59
6.2. Writing Your Own Machine-Language Routines 60
6.3. The Logo Assembler 62
6.3.1. Using the Assembler to Write I/O Routines 63
6.3.2. Syntax of Input to the Assembler 64
6.3.3. Saving Assembled Routines on Disk 67
6.4. Example: Generating music 67
6.5. Useful Memory Addresses 73

7. Miscellaneous Information 77

7.1. Using the Logo System as a Text Editor 77
7.1.1. Printing Files 78
7.2. Self-starting files 79
7.3. Printing to Disk Files 80
7.4. Various System Parameters 82
7.5. Memory Organization Chart 85

Index 87

CHANGES FOR TERRAPIN LOGO VERSION 3.0

Version 3.0 of Terrapin Logo differs from versions 1.0-1.3 in the following respects:

The command to kill a line in the editor is now <CTRL>X instead of <CTRL>K. (This change was necessary to permit use of all four cursor keys.) The most recently deleted line/region can now be Yanked back into the editor with <CTRL>Y.

The <DELETE> key on the Apple IIe can be used to delete backwards one character (just as the <ESC> key does). All four arrow keys may be used in the editor to move the cursor.

Six new primitives have been added: MEMBER?, EMPTY?, ITEM, COUNT, LOCAL, SETDISK

MEMBER? takes two inputs, and outputs "TRUE if the first is a member of the second.
MEMBER? "A "QUARK outputs "TRUE
MEMBER? "A [A B C] outputs "TRUE
MEMBER? "Z [A B C] outputs "FALSE

EMPTY? outputs "TRUE if its input is the empty word or the empty list.
EMPTY? " outputs "TRUE
EMPTY? [ ] outputs "TRUE
EMPTY? "BOB outputs "FALSE

ITEM takes two inputs, a number and a list/word, and outputs the nth element of the second input.
ITEM 3 "TURTLE outputs "R
ITEM 2 [ED RALPH TRIXIE] outputs "RALPH
ITEM 3 [FRED ETHEL [LITTLE RICKY]] outputs [LITTLE RICKY]

COUNT returns the number of elements in its input, which can be either a word or a list.
COUNT "ABC outputs 3
COUNT [SNEEZY GRUMPY SLEEPY DOC] outputs 4
COUNT [SNEEZY GRUMPY [SNOW WHITE]] outputs 3

Other Terrapin Logo Commands

NUMERIC OPERATIONS

+	Addition.
-	Subtraction.
*	Multiplication.
/	Division.
>	Greater than.
<	Less than.
ATAN (2)	Returns the arctangent of the quotient of two inputs.
COS (1)	Returns cosine.
INTEGER (1)	Truncates the fractional part of a number.
NUMBER? (1)	Returns TRUE if input is a number.
QUOTIENT (2)	Returns the integer quotient of two inputs.
RANDOM (1)	Returns a repeatable sequence of random numbers.
RANDOMIZE (0)***	Varies the input seed for random.
REMAINDER (2)	Returns the integer remainder.
ROUND (1)	Returns the nearest integer.
SIN (1)	

The Terrapin™ Logo Language for the Apple® II

Language Disk

64K and 128K Versions

№ 69251

©Terrapin, Inc., 1982, 1983, 1984, 1985.
©M.I.T., 1980, 1981

Terrapin, Inc.
222 Third Street
Cambridge, Massachusetts 02142
(617) 492-8816